Augusta Water Works, 1898
3 miles northwest of Broad Street on
Goodrich Street extension
Augusta
Richmond County
Georgia

HAER GA-16

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Heritage Conservation and Recreation Service
Department of the Interior
Washington, D. C. 20243

HISTORIC AMERICAN ENCINEERING RECORD

AUGUSTA WATER WORKS

HAER GA-16

Location:	3 (?) miles NW of Broad Street on Dirt Extension of Goodrich Street, Augusta, Richmond County, Georgia
Date of Construction:	1897-99, 1909, 1920-21, 1952, 1977
Present Owner:	City of Augusta
Present Use:	Raw Water Pumping Stations
Significance:	When completed in 1899, the Augusta Water Supply system was one of the best in the South and one of the cheapest in the United States. The Raw Water Pumping Stations have always pumped canal water; some stations still use canal water to power the pumps. The complex is also significant because it illustrates the application of three types of power--water, steam, and electric--to the operation of pumps.
Historian:	Alan J. Steiner, August 1977

HISTORY

The Augusta, Georgia, Water Works Raw Water Pumping Stations, constructed 1897-99, were part of a water system with a long history. The city of Augusta, founded in 1735, first distributed water to its citizens via a number of shallow wells and pumps located around the town.[1] In 1828, the City Council granted Thomas McGrew a license to provide the citizens of Augusta with water for twenty-five years. McGrew and Hiram Knowlton, mechanic, collected the flow of Turknett Spring in a stone gutter, passed the water through a strainer in the spring house and sent it to a brick reservoir. From there, six-inch diameter bored logs conveyed the water over two miles to a reservoir within the city. In 1829, McGrew transferred his license to the city's Mayor, Samuel Hale, who operated the works until 1840, when he turned the system over to the City Council of Augusta. Until the late 1850s, the spring system provided sufficient water to meet the needs of Augustans.[2]

In 1857, the Mayor, George B. Evans, suggested that the city required more water and that a new water works be built. As Evans envisioned it, the new system would take water from the Augusta Canal, a power and transportation canal constructed late in the 1840s.[3] The canal water would also drive the pumps which transmitted it throughout the city mains. Two years later, under Mayor Foster Blodgett, Jr., the city improved the Turknett Spring Water Works and constructed a canal water works. A local civil engineer, William Phillips, drew up the plans for both systems.[4]

According to engineer and historian, Thomas Heard Robertson, Phillip's canal water works plan "was an important innovation in its day."[5] Phillips suggested that the city build a water treatment plant consisting of two sets of three basins, each adjacent to the end of the first level of the Augusta Canal. Water would pass from the canal through timber gates into a receiving and settling basin. After several days, during which larger particles settled to the bottom, the water would be conveyed through a fate house to a gravity filter basin paved with brick. From this basin, the filtered water would flow through culverts to a clear water basin.[6] A pipeline then would transfer the water to a water-powered pumping station on the second level of the Augusta Canal...[7] The pumps would send the water to a ninety-four foot high cast iron tank, from which the water would drop to distribution mains.[8]

The city carried out only part of Phillip's scheme. Late in the spring of 1860, a disagreement developed between the city and the earthworth contractors for the project concerning the price for disposing of waste soil. The city discontinued the work with the contractors on the second set of basins. The city intended to let a new contract on the work, but the War Between the States interfered with their plans. Construction materials previously obtained from the North, as well as skilled workmen, were increasingly unavailable. By June 8, 1861, the municipal government considered the system as complete as possible with only one set of basins, the new system has cost the city approximately $187,000.[9]

In the new pumping station, the city installed two double-acting plunger pumps, built by I. P. Morris & Co. of Philadelphia, and a Jonval turbine operating under a head of 11 feet. The pumps had a capacity estimated variously at 4 million to 8 million gallons per day (M.G.D.).[9] Early in the 1870's, the city added a small steam engine with a double-acting force pump to serve as a standby for times when the turbine could not operate.[10] Since the water power was owned by the city and therefore free of charge, any use of steam power was expensive. The storage of pumped, filtered water in the elevated tank permitted the city to avoid running the steam engine.

The enlargement of the Augusta Canal from 1872-1875 resulted in industrial development, and a consequent rise in the city's population. From 1860 to 1880, the population increased by about two-thirds.[11] To meet the water needs of a burgeoning population, the city government financed the construction of a new pumping station at the end of the first level of the Augusta Canal. The new site was across the canal from the receiving and settling basins. The city still held the land to construct a second series of filtering basins, but took no further action in this direction. In the new station, finished early in 1885, the city installed one steam and one water powered pump.[12] The water power pump had a capacity of 5 M.G.D.[13] Again, the steam pump served as a backup and probably was used sparingly. The total cost of the new pumphouse came to $36,750.[14]

By the late 1890's, the municipal government again was making plans to revise the water works system. The population was nearly double that of 1880.[15] The water supplied by the two canal pumping stations soon would become inadequate. The settling and filter basins were not large enough to prevent the pumping of discolored water following periods of muddy water in the Savannah River.[16] The pumped water was occasionally contaminated by decaying sewers and drains before it reached the townspeople.[17] The pressure in the city mains was maintained only by pumping to the elevated tank. Pressure on Broad Street, the heart of the business district, was too low for effective fire protection.[18] The problems of water supply, as well as sewage and garbage, came to the attention of numerous groups of political and social reformers who hoped to clean up the city government as well as the streets of the town.[19]

In the middle of 1897, a Water Works Commission appointed by Mayor W. B. Young hired an experienced university-trained civil engineer, Nisbet Wingfield, to study the water supply and sewage problems and make recommendations for the development of new systems.[20] Wingfield's plan called for the construction of a new pumping station west of Augusta between the canal and the Savannah River. The location of the new station would place it above possible sewage contamination. The station would contain two horizontal piston pumps, driven by two sets of horizontal turbines. Each pump would have a 6 M.G.D. capacity. The pumps would send the canal water to a 50-million-gallon earth reservoir atop a hill in Summerville, an Augusta suburb. The water then would pass through a brick filter plant and empty into a clear water basin. A 24" main would

carry the water, by gravity, down the hill to the existing 116" supply pipe within the city.[21] The municipal government approved Wingfield's new Department of Public Works.[22]

Construction of the new pump station began in November 1897, and was completed by December 1899.[23] Testing of the pumps to determine whether they met the contract specifications, as well as filter problems and mechanical failures at the pump station prevented the final acceptance of the new system by the city until March 29, 1901.[24] The pumps and power equipment for the new station were manufactured by R. D. Woods & Co. The new machinery consisted of two duplex double-acting plunger-type pumps, each with a capacity of 6 M.G.D., driven by two sets of 600 hp., twin runner, horizontal Geyelin-Jonval waterwheels. The pumps took suction from the penstocks, which fed the waterwheels.[25] Excess water dropped twenty-nine feet to the tailrace and the Savannah River.[26] A pipe tapped water from one of the penstocks and dropped it on an overshot wheel suspended behind the rear of the building. The metal wheel drove shafting in the Water Works machine shop which ran a lathe, drill press, and and a dynamo.[27] Wingfield saw his original plans realized and proudly announced that the price of water in Augusta was "cheaper than that in 95% of the cities of the United States."[28]

Wingfield had believed that the two water-powered pumps could supply enough water to build up reserves which would make unnecessary the construction of an auxiliary steam pumping plant.[29] However, in 1908, Augusta suffered a large flood which resulted in canal breaks. The failure

of the canal shut down the city's water-powered industries, as well as the pump station. As the level of fresh water reserves decreased, the need for an auxiliary steam plant to handle just such emergencies became clear. The city soon constructed two additional buildings at the site of the pumping station. In the first, which appeared to duplicate the original pump house, the city installed 3 150-hp boilers.[30] In a circular deep well pump room to the rear of the boiler house, the city placed 1 Wilson and Snyder Compound Duplex steam pump which took suction from the Water Works tail race.[31] The new plant offered protection against loss of fresh water supply during floods, and the city continued to maintain the old 13th Street pump house in case a break occurred between the main from the filter station to the city supply pipe.[32]

Even with the installation of the steam pump, Wingfield saw the eventual need for an additional pumping unit. From 1899 to 1911, consumption of water in Augusta doubled.[33] The city could attempt to reduce consumption or to increase its pumping and storage capacities. Wingfield soon discovered that wastage made up much of the huge increase in consumption.[34] The new pumping stations provided water flow through city mains at a higher pressure. Any leaking or faulty main or home fixture would cause more water to be wasted than before. Wingfield had hoped to avoid the expense of installing and reading water meters, but in 1917, the city made the switch from flat rates to metering. The Federal Government had hoped to locate an Army camp in the Augusta area, but the Army insisted on the availability of a reliable supply of pure water. Without metering, excessive consumption of water in Augusta would

continue, and the city water works would not be able to guarantee a supply for the camp. The city council approved metering, the Army established Camp Hancock outside of Augusta, and consumption of water dropped by some twenty-three percent over the next three years.[35]

In 1918, Jonathan H. Ferguson, Superintendent of the Canal and Water Works, reported that "the general installation of meters was the most progressive step since the building of the new water works," but still he saw a need for additional pumping capacity.[36] In 1919, the city purchased two centrifugal pumps.[37] The Public Works Department planned to install one of these pumps in a new pump station on the south side of the canal across from the main pump house. J. H. Wise, a mechanical engineer from the Lombard Iron Works in Augusta, designed the new building and the pipe connection to the force main.[38] In the new pump house, the city placed one of the two new Allis-Chalmers 7 M.G.D. pumps, along with a 700 horsepower electric motor to drive it.[39] The city ran the electric pump only at night when power rates were lower.[40] By running one water-powered pump during the day and the electric pump at night, the city was able to maintain a satisfactory water level in the reservoir and to overhaul each water-powered pump in turn.[41] The overhauling extenfed the lines of these pumps which, according to W. W. Hunter, Superintendent of the Canal and Waterworks in 1924, "were about ready to break down."[42]

In September and October 1929, the city of Augusta again suffered a flood which resulted in canal breaks. The water power pumps could not

operate until city workers closed and sandbagged the Augusta levee headgates, and a gate spillway and break along the canal.[43] The steam and electric reserve pumps were started up, but both gave considerable trouble to the operators.[44] The force main from the pump station to the filter plant also was troublesome. Considerable blowouts occurred because the steam and electric pumps run simultaneously.[45] The Department of Public Works reacted to these problems by awarding a contract to the Lombard Iron Works to install two turbine electric pumps.[46] These Pomona pumps were placed in the steam pump pit and driven by Westinghouse electric motors atop vertical shafts. The arrangement of motors and pumps permitted their use in high water which flooded the pit. Originally, these electric pumps took suction from the tail race through the same line as the steam pump. Although the Department maintained the steam pump, it apparently never was used again. In 1936, M. B. Cooper, Superintendent of the Canal and Water Works recommended that the city dismantle the steam pumps and boilers and sell the equipment while it still retained some value.[47]

During the Depression, the city of Augusta received assistance from the Federal Public Works Administration (PWA) to construct a modern filtration plant with a 15 M.G.D. capacity.[48] Since the filtration plant was to be modern and have an expanded capacity, E. E. Pund, the city engineer at the time, believed that "modernization of the pumping station must necessarily follow." The city quickly put the money saved on the filtration plant to good use. In 1938, Robert and Co., Inc., Architects and Engineers, from Atlanta, Georgia, who had handled the new filter plant,

prepared plans and specifications for the modernization of the pumping station.[50] Contractors removed the old water wheels and pumps, and installed two 700 hp, twin runner, horizontal shaft, center discharge Leffel turbines, connected to Farrel-Birmingham speed increasers. A shaft, extending from each speed increaser, turned a 7.5 M.G.D. Dayton-Dowd horizontal, double-stage centrifugal pump.[51] The new pumps began operation in 1940, but the city experienced considerable trouble with the pinion gears, bevel gears, and bearings of the speed increasers. Operation of the new pumps did not smooth out until 1945, following the repair of the speed increasers and the replacement of the impellers in both pumps.[52]

In addition to the pump modernization, the city increased its standby capacity. The spare electricity driven Allis-Chalmers pump was placed in the pump house on the south side of the canal.[53] Federal grants supplied the funds for cleaning and rewinding the various electric motors and for moving the suction pipe for the Pomona pumps from the tail race to the canal.[54] With the new pumps and the more certain reserve capacity, the city for some time experienced fewer problems with its water supply.

After the second World War, the U. S. Atomic Energy Commission built an H-Bomb plant in Aiken County, South Carolina, about 18 miles from Augusta. The increase in population resulting from the congregation of a new work force placed some stress on Augusta's public works. Early in 1951, the city engineer, Jonathan D. Twiggs, began negotiations with the Housing and Home Finance Agency of the Federal Government to obtain

advance funds to plan the extension and enlargement of the Augusta Water Works and sewer systems.[55] The city received some Federal money and financed further improvements by selling $3 million worth of water works securities.[56] With some of the money, the city built a new pump station at the water works. The new unit consisted of one Leffel turbine driving a speed increaser which turned a Peerless centrifugal pump.[57] The new pump had a capacity of 20 M.G.D.[58] The installation of this unit probably terminated the operation of the Pomona pump in the deep well building. Gity engineer, M. P. Phillips, noted in 1955 that the additional pump assured the city system of a supply of approximately 30 M.G.D.[59]

The city pumping stations proved adequate for the next twenty years. The pump units installed in 1940 were used only to support the Peerless pump during peak periods and when the newer unit was down for repairs. By the mid-1970's, the Dayton-Dowd pumps alone could not provide an adequate amount of water over a prolonged period.[60] An expansion of the complete water supply system, pumps, filters, reservoirs and distribution system, was necessary to meet the needs of the growing population in the Augusta area.[61] The city made plans for a new pumping station at the water works site to include a 30 M.G.D. Peerless pump and a 20 M.G.D. vertical drive Diesel pump which would take suction from the Savannah River and serve as a standby. A twin runner Leffel horizontal turbine was to drive a Falk speed increaser which would turn the Peerless pump.[62] The new pumps and water wheels were to be installed in late 1977.

Technology in Pumping Stations

In the 1897-99 building, two 700 horsepower units of two horizontal turbines each, manufactured by James Leffel & Co. of Springfield, Ohio, turned shafts attached to two Farrel-Birmingham speed increasers. These have a number of different types of gears which redirected the power and increased the speed of the shaft to 1200 RPM. This shaft extended to two Dayton-Dowd double stage centrifugal pumps. The pump shaft had two impellers. Each impeller added an equal amount of energy to the water which was sucked out of the same penstocks that carried the water to drive the turbines. The pumped water flowed through pipes with gate and check valves to the force main that conveyed it to the city reservoir and filter plant. Excess water dropped into the Savannah River, except for a small amount which was tapped to drive a metal overshot water wheel placed on the rear of one of the wheel houses. This wheel once drove the water works dynamo and its machine shop. The wheel remains, but now electric motors power the machine shop.

The old deep well building which housed first steam and then electric pumps is no longer in use. Two electric motors which ran the old Pomona pumps via vertical shafts remain on platforms in the building, but no pumps remain in place. An exposed pipe, as well as large vents, were among the only indications of the original function of the 1909 boiler house, now used for storage.

The Allis-Chalmers pump building on the south side of the canal still contains the two electrically driven centrifugal pumps, although the

building is boarded up to prevent vandalism and appears to be in disuse. These pumps still provide some backup capacity during rainy periods when the river rises and prevents the operation of waterwheels. In 1977 the city planned to update these electric pumps.[64]

Architecture

In reporting to the Water Works Commission, Wingfield urged that the new pumping station be a permanent and attractive building of brick or stone. His conviction was that an impressive public building would demonstrate the reform adninistration's pride in Augusta and its citizens. Wingfield himself undertook the task of designing the pumping station. The new facility would be built in the eclectic Victorian style and would include such details as Greek revival pediments. The building, as eventually constructed, reflected Wingfield's determination and commitment to make a utilitarian building look attractive and stylish.

The plan of the new complex was a very simple one, consisting of a projecting central pavilion, the pump house, and two flanking wings, the wheelhouses. Several horizontal bands of limestone, which served as the sills and lintels of the windows, gave the three-part brick composition continuity. On the rear facade, which consisted of a single plane, only the interior and exterior corner pilasters carried the limestone bands. The cornice was ornamented with dentils, which, like the rest of the trim, were painted green. The front entrance of the pump station was centered and projected several feet in front of the building. A smaller pediment above the entrance recalled the building's larger pediment.

Although Wingfield had succeeded in giving Augusta a building with apparent sophistication and style, he had little idea of how to integrate this goal with the needs of a functioning pumping station. There was little relation between the detailed exterior facade and the interior, which was actually a large empty space with pumps situated on the basement level. The station was a grand public edifice which might have served any number of functions, least of which might be a pump station.

The importance to Wingfield of the appearance of the water works complex was shown by his design for a 1909 addition, built to house boilers to power auxiliary steam pumps. The engineer planned a building of a size slightly larger than that of the pump house. Whether the building actually had to be a specific size to contain certain equipment is unclear. Wingfield designed this addition in a manner that maintained the balance of the water works complex. Later additions, built after Wingfield left the post of Commissioner of Public Works, did not maintain the carefully balanced plan or the ornamental style of the original buildings.[63]

FOOTNOTES

1. Thomas Heard Robertson, "Notes on the Development of the Augusta Water Works, 1822-1901," The Georgia Operator 14 (Spring 1977), p. 8. Hereafter referred to as Robertson, "Notes."

2. Robertson, "Notes", p. 8; James R. Croes, "The History and Statistics of American Water Works - CXXXVIII - Augusta, Ga., "Engineering News 8 (Nov. 19, 1881). Hereafter referred to as Croes, "History".

3. See HAER Augusta Canal Project, Report #1, Augusta Canal.

4. Robertson, "Notes", p. 9.

5. Robertson, "Notes", p. 9.

6. Robertson, "Notes", p. 9; The first basin was 10 feet deep. Once heavy clay particles had been deposited, the water went to the second basin, 15 feet deep. The second basin, which was "200 ft. square, was originally designed for a filter basin, but the war prevented its completion as such, and the water passes simply through the 1/4 inch joints of the brick paving to the ... clear water basin." Croes, "History."

7. The pump was at Gardiner's Flume. Robertson, "Notes", p. 9.

8. Robertson, "Notes," p. 9.

9. Robertson, "Notes", p. 34.

10. Croes, "History"; Augusta Daily Chronicle and Sentinel, Feb. 3, 1871, p. 3; June 6, 1871, p. 3; August 8, 1871, p. 3.

11. Richard Henry Lee German, "The Queen City of the Savannah: Augusta, Georgia, during the urban progressive era, 1890-1917 (unpublished Ph.D. dissertation, U. of Florida, 1971). p. 28. Hereafter referred to as German, "Progressive."

12. The Sanitary Engineer and Construction Record 16 (Sept. 24, 1887), p. 467.

13. Yearbook of the City Council of Augusta, 1892 (Augusta, 1893), p. 56. Hereafter referred to as Yearbook (dates).

14. Yearbook, 1892, p. 56.

15. German, "Progressive", p. 53.

16. Report of Wingfield, Proceedings, Water Works Commission, City Council of Augusta, Sept. 13, 1897. Vault, City-County Building, Augusta, Georgia.

17. German, "Progressive," pp. 50-54.

18. Report of Wingfield, Proceedings, Water Works Commission, Sept. 13, 1897

19. See German, "Progressive" for background on "reform" in Augusta.

20. German, "Progressive," p. 75.

21. Report of Wingfield, Proceedings, Water Works Commission, Sept. 13, 1897.

22. German, "Progressive," p. 75.

23. Robertson, "Notes," p. 34.

24. Robertson, "Notes," p. 34.

25. Robert & Co., Inc., "Report on Filtration Plant and Recommendations for Proposed Filtration Plant Improvements for City of Augusta, Augusta, Georgia, 11 Dec. 1936, p. 3.

26. The figure 29 feet is from Report of Wingfield, Proceedings, Water Works Commission, Sept. 13, 1897.

27. The author saw a metal overshot wheel when touring the water works site and asked a current employee about its purpose. Also see report of Jonathan H. Ferguson, Superintendent of Canal and Water Works, Yearbook, 1918 (Augusta, 1919), p. 47.

28. Report of Nisbet Wingfield, Commissioner of Public Works, Yearbook, 1905 (Augusta, 1906), p. 76.

29. Report of Wingfield, Proceedings, Water Works Commission, Sept. 13, 1897.

30. Robert & Co., Inc., "Report on Filtration Plant....," p. 3. This report included a report on "The Existing Plant, Its Capacity, Physical Condition, and Results Being Obtained" and thus described the Raw Water Pumping Station.

31. Robert & Co., "Report on Filtration Plant...," p. 3.

32. See Yearbooks, 1911-1920, reports of Commissioners of Public Works and Superintendents of Canal and Water Works.

33. Report of Nisbet Wingfield, Commissioner of Public Works and City Engineer, Yearbook 1911 (Augusta, 1912), p. 27.

34. Report of Nisbet Wingfield, Commissioner of Public Works and City Engineer, Yearbook 1915 (Augusta, 1916), p. 29.

35. Message of Mayor Littleton, Yearbook 1917 (Augusta, 1918), p. 14. Message of Mayor Littleton, Yearbook 1918 (Augusta, 1919), p. 14.

Report of W. H. Wise, Commissioner of Public Works, Yearbook 1921 (Augusta, 1922), p. 57.

36. Report of Jonathan H. Ferguson, Superintendent of Canal and Water Works, Yearbook 1918, (Augusta, 1919), p. 50.

37. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1919 (Augusta, 1920), p. 36.

38. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1919 (Augusta, 1920), p. 36; Report of W. H. Wise, Yearbook 1921 (Augusta, 1922), p. 57.

39. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1922 (Augusta, 1923), p. 59; Robert & Co., "Report on Filtration Plant...," P. #.

40. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1922 (Augusta, 1923), p. 59.

41. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1922 (Augusta, 1923), p. 59, 77.

42. Report of W. W. Hunter, Superintendent of Canal and Water Works, Yearbook 1923 (Augusta, 1924), p. 85.

43. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1929 (Augusta, 1930), p. 53, 60.

44. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1929 (Augusta, 1930), p. 53-60.

45. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1929 (Augusta, 1930), p. 60.

46. Report of W. H. Wise, Commissioner of Public Works, Yearbook 1929 (Augusta, 1930), p. 60.

47. Report of M. B. Cooper, Superintendent of the Canal and Water Works, Yearbook 1936 (Augusta, 1937), p. 98.

48. Report of E. E. Pund, Commissioner of Public Works, Yearbook 1937 (Augusta, 1938), p. 73.

49. Report of E. E. Pund, Commissioner of Public Works, Yearbook 1937 (Augusta, 1938), p. 73.

50. Report of E. E. Pund, Commissioner of Public Works, Yearbook 1938 (Augusta, 1939), p. 73.

51. Copy of "Advertisement Specifications Proposal, Form of Contract and Bonds for Raw Water Pumping Improvements, Unit No. 5, City of Augusta, Augusta, Georgia" - Revised March, 1939, Files, Robert & Co., Atlanta, Georgia.

52. Reports of E. E. Pund, Commissioner of Public Works, Yearbook 1941 (Augusta, 1942), pp. 65-66; Yearbook 1942 (Augusta, 1943), pp. 61-62; Yearbook 1943 (Augusta, 1944), pp. 66-67; Yearbook 1944 (Augusta, 1945), pp. 68-69; Yearbook 1945 (Augusta, 1946), p. 68.

53. See "Advertisement - Specifications...", p. 3, Files, Robert & Co.

54. Reports of E. E. Pund, Commissioner of Public Works, Yearbook 1941 (Augusta, 1942), pp. 65-66; Yearbook 1942 (Augusta, 1943), p. 61.

55. Jonathan D. Twiggs, Annual Report of the City Engineer and Commissioner of Public Works, Yearbook 1951 (Augusta, 1952), p. 45.

56. Jonathan D. Twiggs, Annual Report of the City Engineer and Commissioner of Public Works, Yearbook 1951 (Augusta, 1952), p. 45.

57. Phone conversation with Fred Gary, Superintendent of Canal and Water Works, August 31, 1977.

58. Phone conversation with Fred Gary, August 31, 1977.

59. Report of M. P. Phillips, City Engineer, Yearbook 1954 (Augusta, 1955) p. 42.

60. Report of Fred Gary, General Superintendent, Waterworks Operations, Yearbook 1975 (Augusta, 1976).

61. Phone conversation with Fred Gary, August 31, 1977.

62. Phone conversation with Fred Gary, August 31, 1977.

63. The author is indebted to Bob Jorgensen, Student Historian, and Scott Ageloff, Student Architect, HAER Augusta Canal Project, for architectural description and ideas.

64. Phone conversation with Fred Gary, August 31, 1977.

BIBLIOGRAPHY

City Documents

Yearbooks of the City Council of Augusta, Ga., 1892, 1898, 1904-06, 1908, 1911-1975.

Information about the Water Works in Mayor's Addresses, Reports of Commissioners of Public Works and Superintendents of Canal and Water Works.

Company Records

Robert and Company, Inc., Architects and Engineers. Atlanta, Georgia.

Company papers and blueprints involving work done for city of Augusta in 1936 and 1939.

Newspapers

Augusta Daily Chronicle and Sentinel, 1871.

Articles concerning problems at Water Works and addition of steam pump.

Periodical Articles

Croes, James R., "The History and Statistics of American Water Works - CXXXVIII - Augusta, Ga.," Engineering News 8 (Nov. 19, 1881).

Provided additional information about the early history of the Augusta Water Works.

Robertson, Thomas Heard, "Notes on the Development of the Augusta Water Works 1822-1901," The Georgia Operator 14 (Spring 1977) 8-9+

Well researched article by local engineer.

The Sanitary Engineer and Construction Record 16 (Sept. 24, 1887), p. 467.

Note stating that Augusta Water Works was enlarged in early part of 1885.

Telephone Conversation

With Fred Gray, Superintendent of Canal and Water Works, August 31, 1977.

Provided information on recent developments.

Unpublished Material

German, Richard Henry Lee, "The Ocean City of the Savannah: Augusta, Georgia, during the urban progressive era, 1890-1917" (unpublished Ph.D. dissertation, U. of Florida, 1971).

Contained background information on reform in Augusta.